ment killing the tissue and thus preparing the way for the growth of the fungus.

De Bary was of the opinion that fungi living thus were in an intermediate stage between parasites and saprophytes, and were gradually changing their method of growth from one to the other. However this may be, it seems to me that as these fungi do not materially differ in other respects from numbers of other fungi, we may expect to find that this method of growth is far from uncommon.

It is a well established fact that one group of fungi, bacteria, grow in this way and thus produce the so-called germ diseases. Thus it would seem that these fungous diseases, if not fungous diseases in general, are essentially the same in nature as the bacterial diseases. The production of a chemical poison in these fungi may either be simply a product of their growth, or may be a special adaptation of these organisms for obtaining food. I should incline to the former view as the more probable one. On the chemical nature of this product, and its destructiveness to any associated organisms must depend the efficiency of the fungus as an agent of disease.

It has been my purpose in this article to indicate by a few examples taken as representatives, that what has been shown to be true of one group of fungi (bacteria) as disease agents, is true of numbers of others, and that the so-called "toxic theory" of disease is capable of extension to fungous diseases in general.

Ursino, Elizabeth, N. J.

Apical growth in roots of Marsilia quadrifolia and Equisetum arvense.

WM. M. ANDREWS.

In the study of apical growth in the roots of these plants, I have found some points differing from previous accounts and perhaps worthy of note. The following will embrace these points and also the methods and sectioning employed.

The principal points in regard to cell division in the apices of the roots of these plants have already been thoroughly discussed by Goebel[1] and De Bary[2], and will not be repeated here.

Fig. 1 represents the apex of the root of Marsilia in longitudinal section. Underneath the dermatogen is a single layer of hypodermal cells, which has a common initial cell with the dermatogen. This hypodermal layer (h, fig. 1), divides no more by tangential walls but remains a single layer.

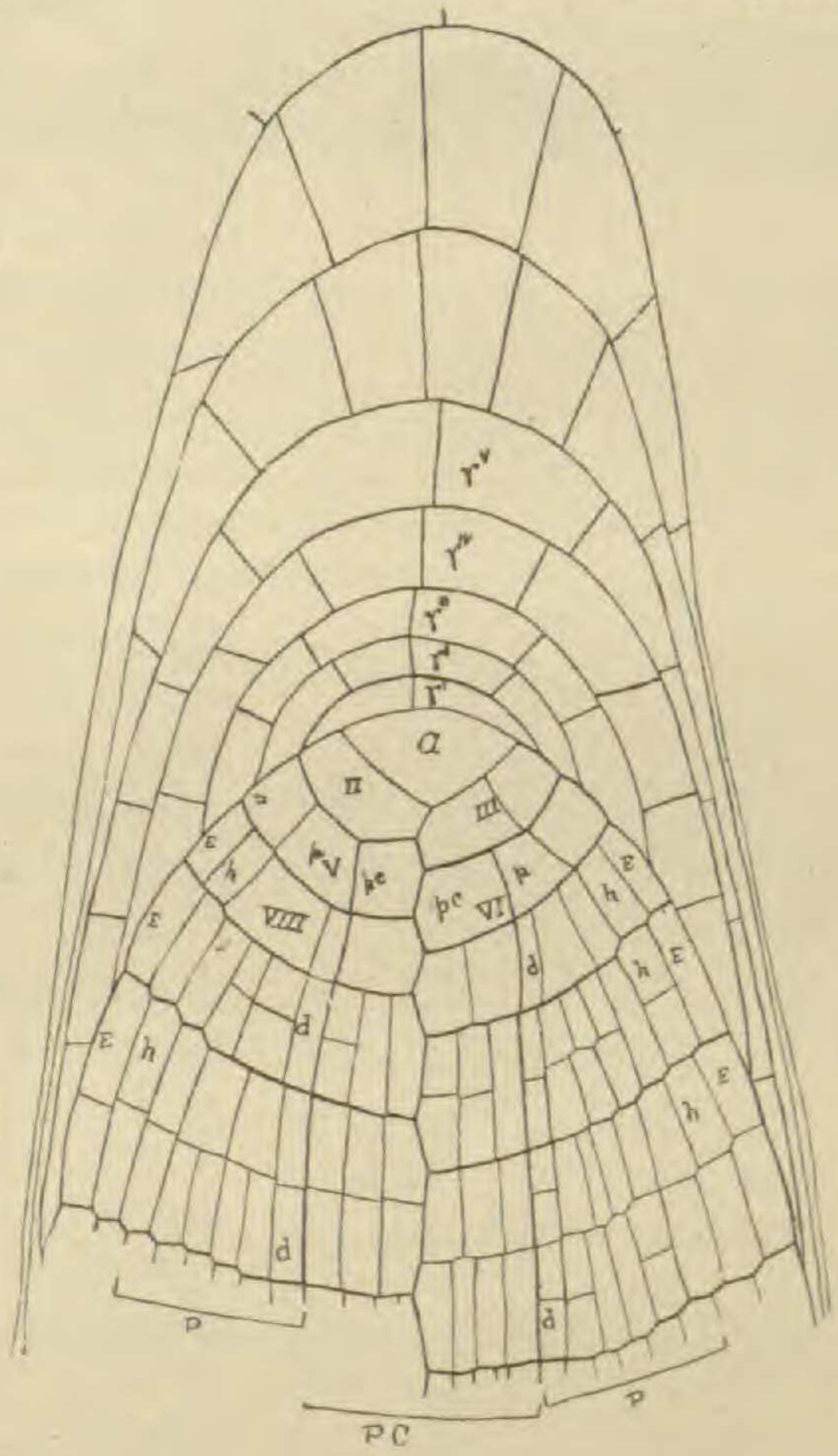

FIG. 1.

Goebel[3] represents the transition from the bulky initial cells into the long narrow cells of the plerome cylinder, as taking place very abruptly, at about the 6th segment. The species figured was Marsilia sylvatrix. In the case of M. quadrifolia, I have noticed a marked difference. Here the transition is very gradual. From the time when the initial cells are cut off, the three tissues, dermatogen, periblem and plerome, are distinctly different.

The root-cap is formed from segments cut off from the base of the pyramidal apical cell. After every three segments cut off from the sides of this cell, there is one cut off from the base. This basal segment is, in the first place, divided into halves then quadrants, by walls which are nearly perpendicular to each other and to the outer surface of the segment. (See fig. 1.) Each of these cells is similarly divided, but there is much less regularity in the position of

[1] GOEBEL.—Outlines of Classification and Special Morphology of Plants. English Edition, 1887, pp. 265, 236–37.

[2] DE BARY.—Comparative Anatomy of the Phanerogams and Ferns. English Edition, 1884, pp. 17–20.

[3] GOEBEL.—l. c. p. 233.

the newer walls. The process of growth soon obliterates the regular arrangement of all but the first two walls.

There is no division of the root-cap segments parallel to the outer surface as figured by Goebel[4]. In Equisetum arvense there is no hypodermal layer as in Marsilia. The endodermis (d. fig. 2) divides into two layers at about the 5th or 6th segment[5]. These two layers are not further divided by tangential walls. The root-cap divides for a while, in the same way as in Marsilia. But now a new sort of division takes place. This is not noted in any of the authors to which I have access. A wall is formed, in part or all the cells of the root-cap, parallel to its outer surface (fig. I, r^{ii} and r^{iii}). As growth continues and the cells of the root-cap diverge from the apical cell, their connection with each other becomes looser. They also lose their regular and somewhat radial position. From the first the root-cap is distinctly different from the dermatogen, and in a less degree the dermatogen, periblem and plerome are differentiated.

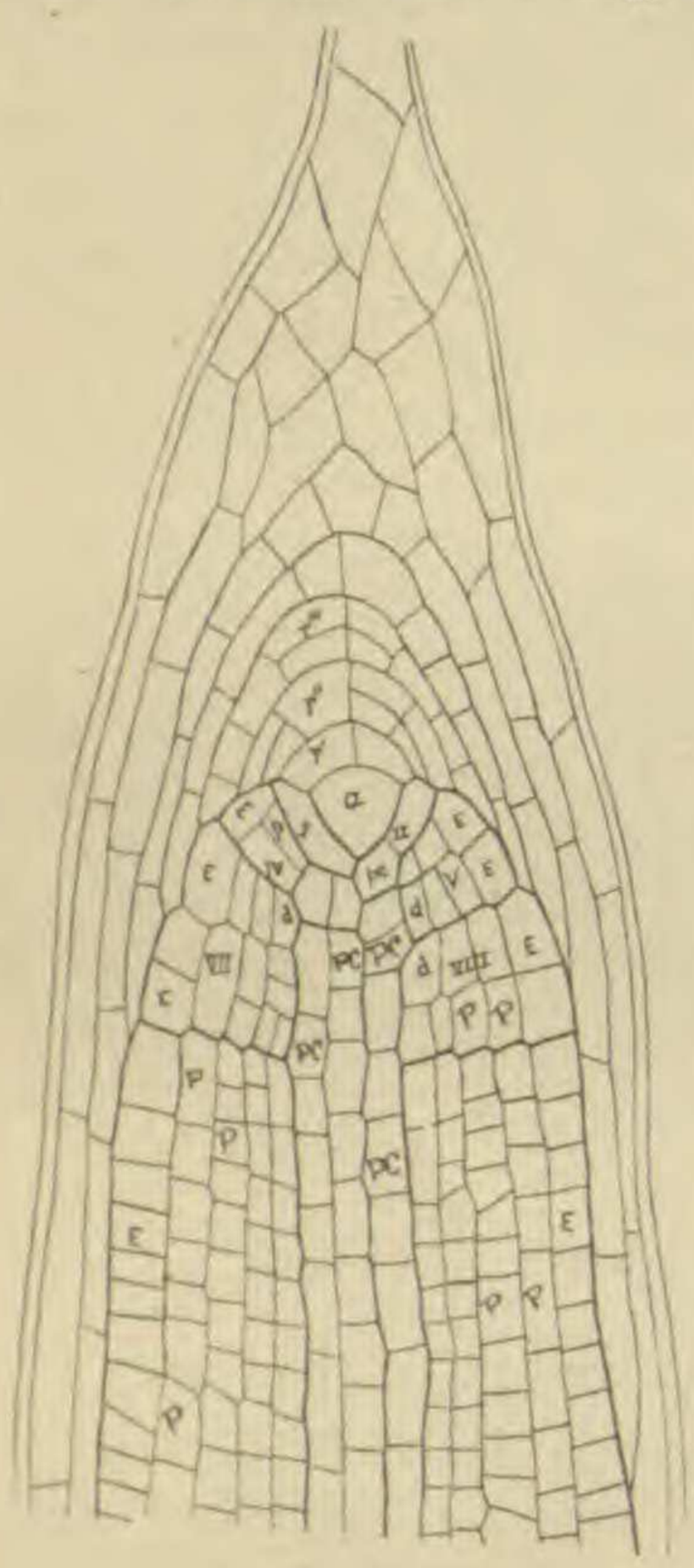

FIG. 2.

The paraffin imbedding process was used in making the sections. The stain used was alum cochineal for Equisetum, staining *in toto*. The roots of Equisetum were hardened in absolute alcohol, although chromic acid was also satisfactory. When hardened in chromic acid, the stain washes out and necessitates staining on the slide. The following is a formula of the methods employed:

	HOURS.
Harden in absolute alcohol or chromic acid	3–24
If in chromic acid, thoroughly wash.	
Stain in alum cochineal	3–24
Wash in distilled water five minutes.	
Dehydrate in 30%, 50%, 70%, 90% and absolute alcohol	3 each
Absolute alcohol, two parts, chloroform, one part	3 "
Absolute alcohol, one part, chloroform, two parts	3 "
Chloroform and paraffin (saturated solution)	3 "
Melted paraffin	3–12
Imbed.	

[4]See preceding note.

[5]Sachs, Text-book, p. 124, 2d English edition. De Bary, l. c., pp. 122, 351, 414.

The roots of Marsilia were hardened with chromic acid and stained on the slide with gentian violet. The methods employed with Equisetum gave good results in this case also. The sections were made with a Minot microtome and ran 1800 to the inch.

EXPLANATION OF FIGURES 1 AND 2.—Drawn with a Zeiss camera. Fig. 1, longitudinal section of root-tip of Marsilia quadrifolia ×300. Fig. 2, same of Equisetum arvense ×187. In both figures the reference letters are as follows: *a*, apical cell; II, III, V, VI, etc., segments of body of root; *P*, periblem; *p*, initial cells of periblem; *P C*, plerome cylinder; *p c*, initial cells of plerome cylinder; *E*, dermatogen; *h*, hypodermal layer; r^{i}, r^{ii}, r^{iii}, $r^{i,v}$ r^{v}, successive segments of root-cap; *d*, endodermis.

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BRIEFER ARTICLES.

Origin of the honey-secreting organs.—A few sentences from Stadler's work "Zur Kenntniss der Nectarien"[1] seem to me to throw some light on the probable origin of the honey-secreting organs of flowers.

He says (I give free translations): "The vessels which are always present, if not in the tissue of the nectary itself, then in its substratum, are usually very strongly developed, terminating in the border of the gland tissue; indeed their more delicate elements, the cambiform, penetrate it."[2]

Also: "The nectaries not only satisfy the demand of insects for honey, but also account for the loss of water through evaporation, which is always considerable."[3]

And again: "In the vicinity of the nectary I found almost without exception some chlorophyll-bearing tissue. Even in regions where, because of other conditions, one would not expect it; as in Lilium auratum under the nectary between the two vascular strands; in the hood and in the anther-column of Asclepias Cornuti, etc. These chlorophyll tissues may by themselves alone, or together with others further away, be the laboratories for the manufacture of the carbo-hydrates which the nectaries need; they may, under no circumstances, give them to the nectary in a form directly capable of secretion."

The first of these statements is not surprising. In order to supply stamens and ovaries with the food materials so abundantly stored in pollen grains and ovules, there should be a strong current of water continu-

[1] "Beitrage zur Kenntniss der Nectarien und Biologie der Blüthen" von Dr. Stadler. Berlin, 1886.

[2] P. 69.

[3] P. 70.